INSTRUCTION MANUAL

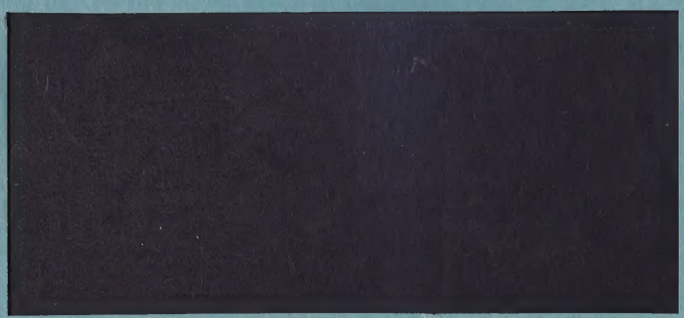
FOR

PRECISION DC VOLTMETER

MODEL DC-100A

ELECTRONIC INSTRUMENTATION FOR INDUSTRY

CALIBRATION STANDARDS CORPORATION *a subsidiary of* ROYAL INDUSTRIES, INC.



PRECISION DC VOLTMETER

MODEL DC-100A

SERIAL # 653

CALIBRATION STANDARDS CORPORATION

ALHAMBRA CALIFORNIA

CUmberland 3-8156

TABLE OF CONTENTS

Introduction

Operating Instructions

Circuit Description

Calibration

Warranty

Sales Data Sheet

Schematics

Short Form Catalogue

IMPORTANT

FOR OPTIMUM RESULTS PLEASE READ THE INSTRUCTION MANUAL CAREFULLY.

This instrument you have purchased represents a major advance in the field of transistorized precision test equipment.

You will find that this meter has many advantages not found in equipment costing many times more.

Since this instrument incorporates the latest engineering techniques and design, it is imperative that you become familiar with the proper operating procedure.

One of the advantages found in this instrument is that there are no electronic zero controls. The meter is zeroed by the mechanical adjustment screw on the meter itself while the instrument is operating.

Since the meter is zeroed in this manner it is possible that when the instrument is turned off the needle will show an offset from zero. This is normal.

PRECISION DC VOLTMETER
DC 100A

OPERATING INSTRUCTIONS

1. The line cord should be plugged into 117 volts 60 cycle power.

2. Turn null selector to the V.T.V.M. position and let unit warm up for about ten minutes.

3. After warm up, zero meter by the mechanical zero adjustment.

4. Turn the range selector to the desired range and connect the voltage to be measured to the terminal posts. Either the positive or negative terminal may be grounded to the common terminal or the input may be left floating.

5. When the voltage is applied, the V.T.V.M. will measure it to an accuracy of ±4%. If the needle goes to the left, reverse the input connections.

6. Set the first two readout dials to this approximate reading and advance the null selector to the 1 volt position. Continue to adjust the rest of the readout while increasing the null sensitivity.

7. When the null selector is at full sensitivity (1MV) and the meter is reading zero, read the voltage from the Kelvin Varley dials to an accuracy of better than ±.05% + 5 microvolts absolute. You may not get a reading of zero if the voltage you are measuring is fluctuating.

READING EXCURSIONS ABOUT A NOMINAL VOLTAGE

8. To read excursions of voltage about a nominal value, set the readout dials to the nominal value and observe the excursions directly on the meter on any of the four null ranges. A right hand deflection of the meter indicates the voltage has increased above the nominal value by the amount indicated on the meter. For voltages read on the 10 volt range and below, use null sensitivity as marked. On the 100 volt ranges, the value must be multiplied by a factor of 10 and the 1000 volt range, multiply by a factor of 100.

MEASUREMENTS BELOW 1 VOLT IN DIFFERENTIAL MODE

9. When making measurements below 1 volt, turn Range Selector Switch to the .1 volt position; set Null Selector to the 1 mv position; set all readout dials to zero and short positive and negative input terminals together.

10. Now set the mechanical meter adjustment to zero. This will cancel out error due to zero offset between the 1 millivolt range and the V.T.V.M. range.

CIRCUIT DESCRIPTION

Precision Voltmeter Model DC-100A is completely transistorized and designed for long, trouble free life. There are no batteries or other parts that would normally need replacing, except the electro-mechanical chopper.

The voltmeter operates on the principle of comparing an unknown voltage with an adjustable know voltage. A sensitive null detector is used to detect when the voltages are equal.

The voltmeter is composed of three (3) basic elements:

(1.) Ultra Stable Reference Supply.
(2.) Accurate Kelvin Varley Divider.
(3.) Sensitive null detector.

1. The heart of the voltmeter is the ultra stable reference supply. This supply is a dual regulated transistor supply powering a compensated Zener reference string. The regulation for a line change of 100 volts to 130 volts is better than $\pm$.005%. The temperature co-efficient of the reference supply is better than .0005%/^{o} C. over a temperature range of 10^{o} C to 40^{o}C. The supply is usuable above 40^{o}C with a slight derating of TC and line voltage regulation.

Long term stability of the reference supply is better than ±.005%/year. This reference supply is constructed as a plug-in module and can be supplied complete from the factory for ease of servicing.

2. The second basic element is the very accurate Kelvin Varley Divider. The first two decks are composed of 11 precision wire wound resistors per deck.

   The first deck has resistors matched to ±.0025% and the second deck has resistors matched to ±.005%. The last three readouts are accomplished with a selected precision 10 turn potentiometer.

   The linearity of this potentiometer is better than ±.05%. The two decks and the 10 turn potentiometer are matched together to produce an overall divider accuracy of better than ±.01% absolute.

   The range selector preceeds the Kelvin Varley Divider. Each range has a fine adjustment potentiometer for calibration and is calibrated separately except that the 10 volt range must be calibrated first.

3. The third element is a very sensitive and stable calibrated null detector. This null detector is used to indicate the difference between the unknown external voltage and known internal voltage.

At maximum sensitivity the null detector has a full scale deflection of 1 mv. This is ample sensitivity for accurate low level voltage measurements. The V.T.V.M. accuracy is ±4% of full scale over a temperature range of 20°C to 30°C. The instrument is usuable to 40°C but some derating should be considered.

It is not recommended that the instrument be operated above 45°C.

The null detector is capable of a long trouble free life except for the occasional replacement of the chopper. This is a James C-1800 chopper. Choppers are in stock at the factory.

Occasional calibration of the null detector may be made by adjusting the gain adjustment potentiometer at the top of the plug-in amplifier module.

The null detector is capable of large overloads without damage. On the 1 mv range a safe overload would be 50 volts short term and 10 volts long term. On the 10 mv, 100 mv and 1V positions, a safe overload of 500 volts is possible.

On the V.T.V.M. ranges, safe overloads are as follows:

.1	volt range:	20 volts
1	volt range:	70 volts
10	volt range:	250 volts
100	Volt range:	700 volts
1000	volt range:	1500 volts

CALIBRATION OF DC-100A

A diagram in this manual shows the location of the calibration potentiometer and a setup for calibrating the voltmeter. The calibrator used in this calibration is designed and built by CALIBRATION STANDARDS CORPORATION. The resistors used in the divider are accurate to .002%. The calibrator has a built in null detector and 100 volt regulated power supply. A Calibrated Standard Cell or Zener reference must be supplied. Price of the calibrator will be given upon request. If the CALIBRATION STANDARDS CORPORATION calibrator is not used, instrument of .01% accuracy or better should be used to calibrate the precision voltmeter.

Calibrate the 10 volt range first by adjusting the 10 volt calibration trim potentiometer when the voltmeter is reading 10 volts with an exact 10 volts applied. Next repeat the same procedure on the 1 volt range using the 1 volt calibration pot. Repeat procedure on .1 volt range. On these ranges the meter has an infinite input resistance at null.

Now set the range switch to 100 volts and apply 100 volts to the meter (2 Meg. input resistance). Adjust the 100 volt calibration pot. This same procedure may be done on the 1000 volt range by applying 1000 volts and adjusting the 1000 volt calibration pot. In the case of the C.S.C. set-up, the 1000 volt range is calibrated with 100 volts by setting the K.V.D. dial to 100 volts on the 1000 volt range. In order to calibrate the meter this way you

must accurately measure the linearity of the divider and make corrections. Even if this correction is not made, a possible error of about .01% may result on the 1000 volt range only.

This completes the calibration of the differential section of the voltmeter.

To calibrate the V.T.V.M. ranges, set the range selector to the 10 volt position and apply 10 volts. Adjust the potentiometer at the top of the amplifier plug-in module for full scale deflection.

MEASUREMENTS ABOVE 10 VOLTS WHEN READINGS ARE TAKEN FROM PANEL METER

When making measurements where readings are taken directly from the panel meter and on the 10 volt range and below, use full scale values as marked on the front panel.

(Calibration of DC-100A Cont.)

On the 100 volt range, multiply the reading by a factor of 10. On the 1000 volt range, multiply the reading by a factor of 100. Due to the circuit design on the 100 volt range, the null detector will have reduced gain on the 1 mv and 10 mv position. This is due to a high internal source impedance of the high voltage input divider.

The gain is about 50% less in the 1 mv null position and about 15% less on the 10 mv position. Only a very slight loss of gain is noticed on the other null ranges. When the range selector is in the 1000 volt position a 10% loss of gain will be noticed in the 1 mv position. The other null ranges will have only a very slight loss of gain.

WARRANTY

The CALIBRATION STANDARDS CORPORATION warrants each instrument to be free from defects in material and workmanship. Material not covered by this warranty are fuses and choppers. The instrument must be returned to the factory with shipping prepaid and a complete report of the difficulty. This warranty is good for one year from the shipping date.

SHIPPING DAMAGE

If there is any damage to the instrument upon receipt, report this to the transportation Claim Agent immediately.

Calibration Standards Corporation

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Model DC-100A

PRECISION DC VOLTMETER

FULLY TRANSISTORIZED

Calibration Standards Corporation

ACCURACY

±.05% + 5 microvolts
absolute from 0 to 1000 volts D.C.

STABILITY ±.005% for a line change of 105 volts to 125 volts.

- Ultra stable Zener package for reference.
- Transistorized throughout, no vacuum tubes or batteries.
- Light weight and portable—9 lbs.
- No equal in simplicity of operation.
- Recorder Output (25mv).
- 0-10 volts output from Kelvin Varley divider.

GENERAL DESCRIPTION

The Model **DC-100A D.C. VOLTMETER** is a compact potentiometric voltmeter designed to measure D.C. voltages to an accuracy of better than ±.05% absolute. Below 10 volts the meter has an infinite input resistance at null. Above 10 volts the input resistance is two megohms.

The instrument has a 5 digit readout with the last 3 digits readout on a precision 10 turn potentiometer. By using a multiturn potentiometer at the end of the Kelvin-Varley divider a very high resolution can be obtained.

PRECISION D.C. VOLTMETER DC-100A

Calibration Standards Corporation

ELECTRONIC INSTRUMENTATION FOR INDUSTRY

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SPECIFICATIONS

VTVM RANGE	0-.1v., 1v., 10v., 100v., 1000v. full scale.
NULL RANGES	0-1mv., 10mv., 100mv., 1 volt full scale. (Times 10 on the 100 volt range.) (Times 100 on the 1000 volt range.)
ACCURACY of PRECISION RANGES	±.05% + 5 microvolts absolute from 0 to 1000 volts D.C.
ACCURACY of VTVM	±4% of full scale.
INPUT RESISTANCE	Infinite at null below 10 volts, 2 megohms above 10 volts. VTVM Resistance — 1000 volts, 100 volts, 10 volts } 10 megohms 1 volt — 1 megohm .1 volt — 100 K 100 megohms/volt on null ranges except 1 volt null range — 10 megohms. When KVD knobs set to zero.
STABILITY of REFERENCE	±.005% for a line change of 105 volts to 125 volts. ±.0005% (5 PPM)/°C over a temperature range of 10°C to 40°C.
WARMUP	Less than 10 min.
INPUT VOLTAGE	117 v.a.c.—60 c.p.s.
INPUT POWER	Less than 3 watts.
WEIGHT and SIZE	9 LBS. 8"w. 7"h. 6"d.
PRICE	$475.00 F. O. B. Pomona, California.

MODEL DC-100A The Model **DC-100A D.C. VOLTMETER** is capable of very precise measurement of D.C. voltages. A very stable Zener package is used as the reference. The temperature coefficient is better than ±.0005%/°C over a temperature range of 10°C to 40°C. Long term stability is approximately ±.01%/year.

The null indicator is a stable transistorized chopper amplifier having a full scale deflection of 1mv. Zero offset is so small that there is no need for a front panel zero control, simply zero the meter with the mechanical meter adjustment. Large overloads will not damage the amplifier or panel meter.

The Kelvin-Varley divider is composed of two switch dividers and a precision 10 turn potentiometer. The resistors in the two dividers are matched to each other and the switches and potentiometer then matched to each other to produce an overall dividing accuracy of better than ±.01%.

Calibration Standards Corporation

1031 WESTMINSTER AVENUE
ALHAMBRA, CALIFORNIA

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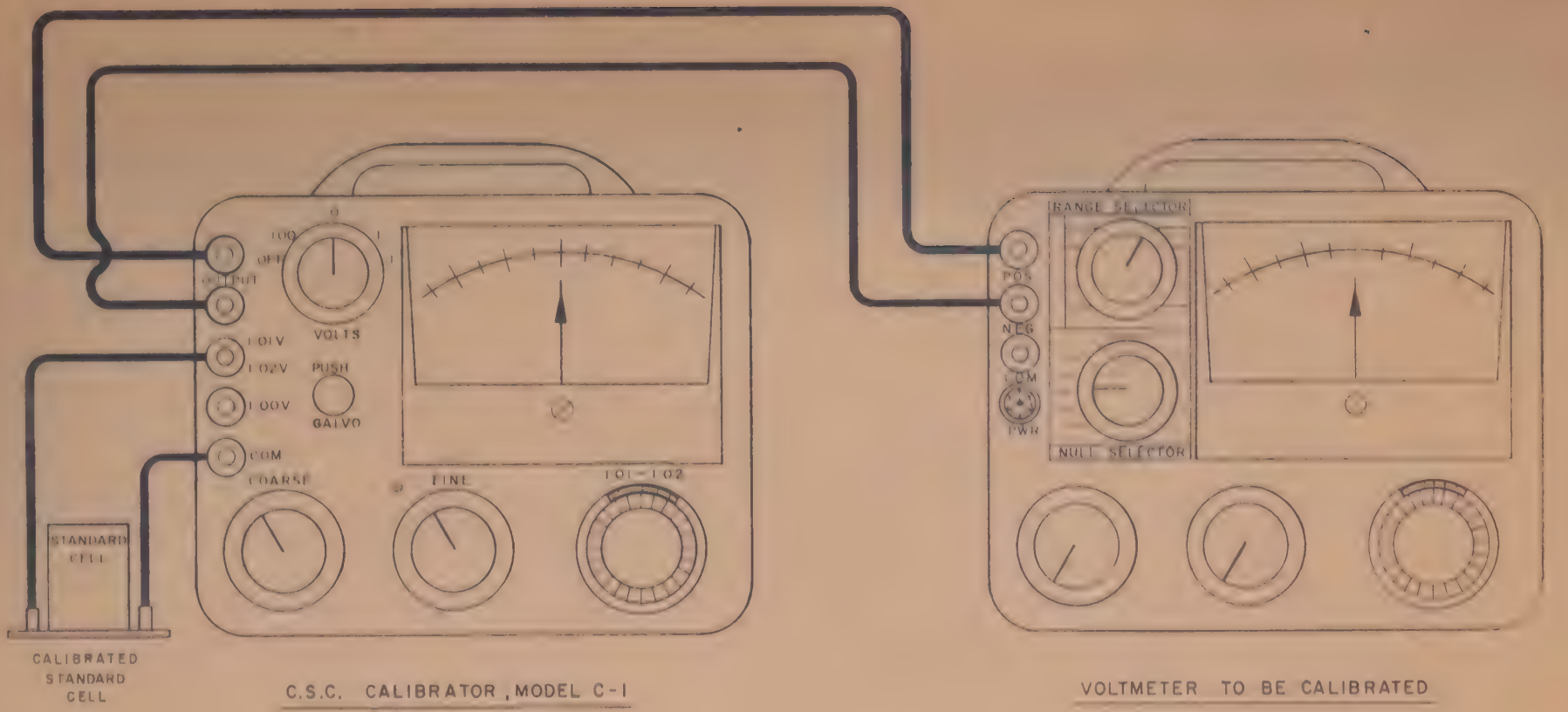

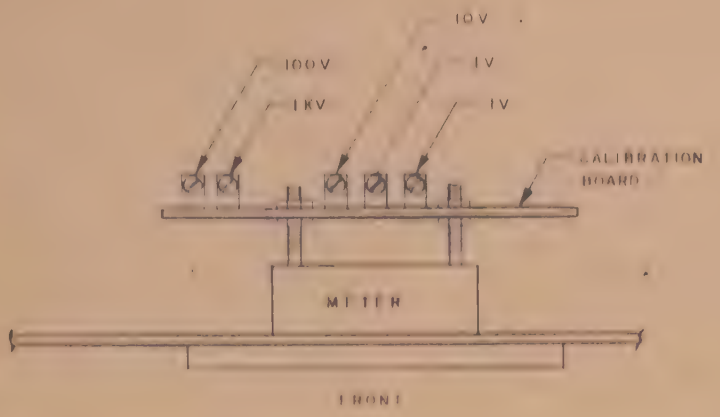

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SCALE NONE	APPROVED BY	DRAWN BY W.A. LAIRD
DATE: 2-3-60	CHECKED BY:	REV SEE

D.C. CALIBRATION SETUP

PRECISION VOLTMETER CV-1	DRAWING NUMBER 340-00	A

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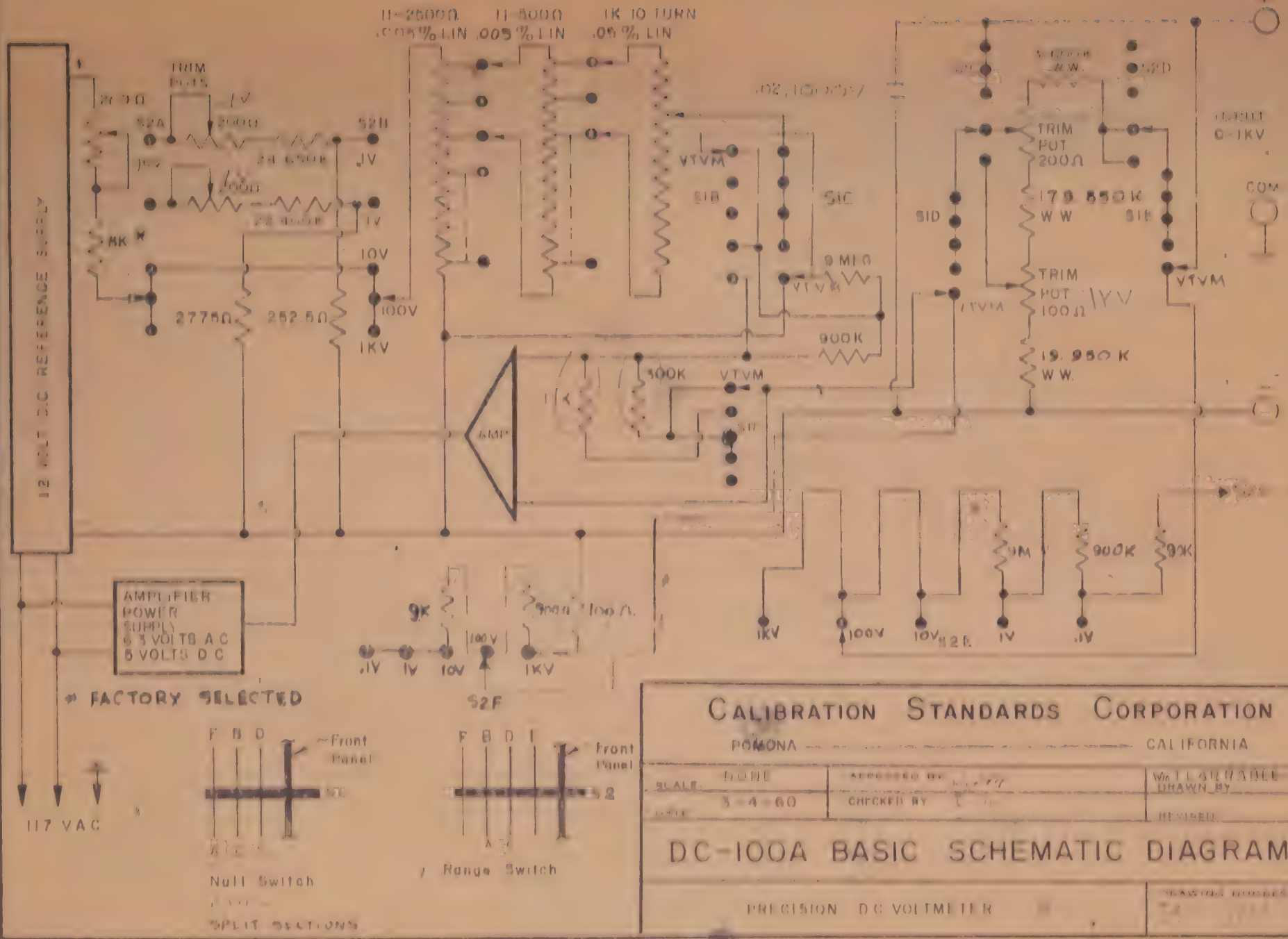

CALIBRATION STANDARDS CORPORATION

POMONA — CALIFORNIA

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		REVISED

DC-100A BASIC SCHEMATIC DIAGRAM

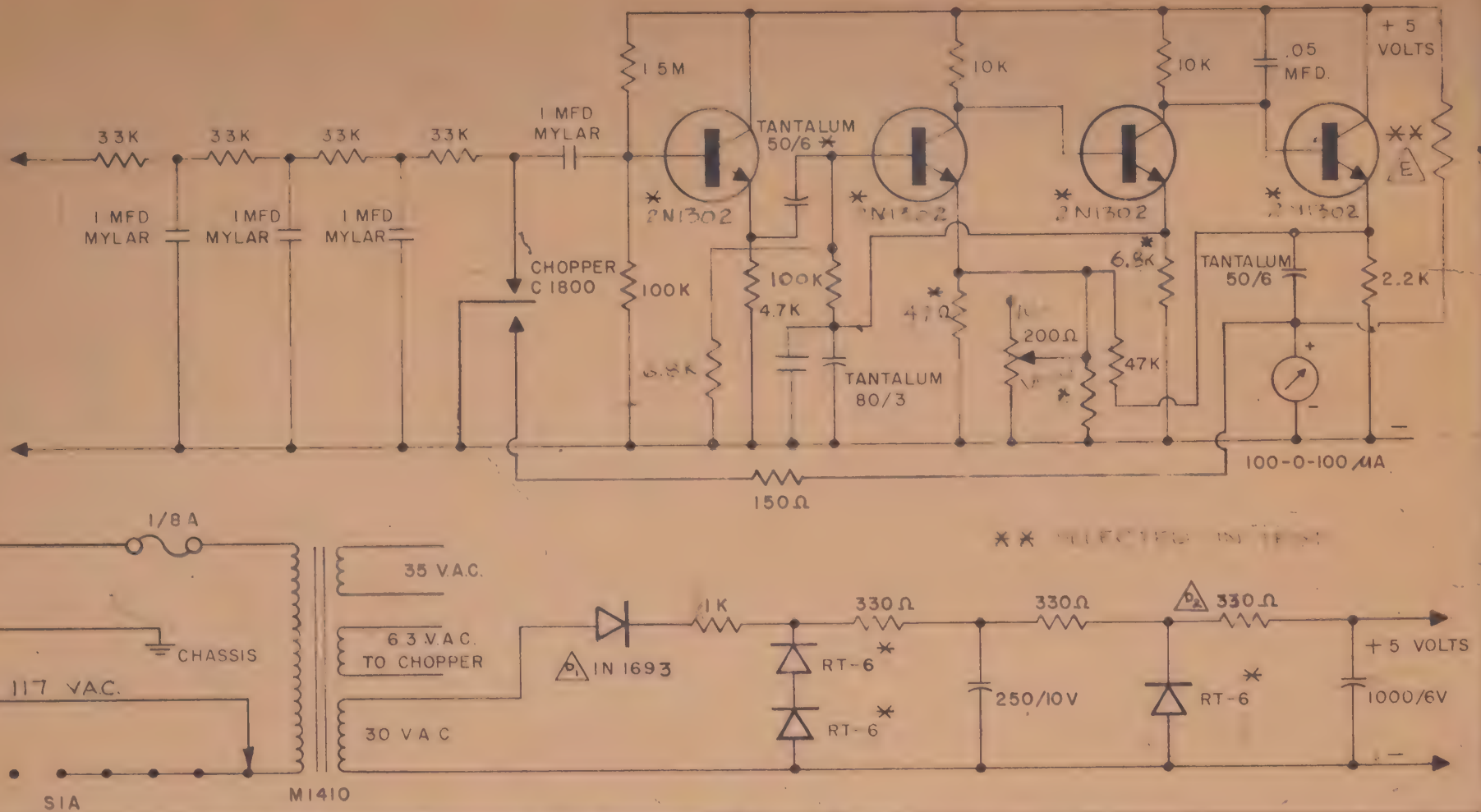
PRECISION D C VOLTMETER

DRAWING NUMBER — ISSUE

PRINTED ON NO. 1000 CLEARPRINT

REVISED AND REDRAWN	7-14 60	C	WATL
IN1693 WAS IN1692, 330Ω WAS 150Ω	10-12-60	D	WJF
[illegible] AND RESISTOR [illegible]	11-7-60	E	WJF

E



	* FACTORY SELECTED		TOLERANCES EXCEPT AS SHOWN: FRACTION ±	DATE 2-2-60 DWN: Wm T Larrabee APPD
	RESISTORS, 1/2 WATT 10%.			
	METER, SIMPSON MODEL 1329.			
	CHOPPER, JAMES C1800			
DET.	MATERIAL	QTY.	ANGLES ±	SCALE

CALIBRATION STANDARDS CORPORATION
POMONA — CALIFORNIA

SCHEMATIC, AMPLIFIER

NEXT ASSEMBLY:
USED ON: ALL INSTRUMENTS

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ISSUE E

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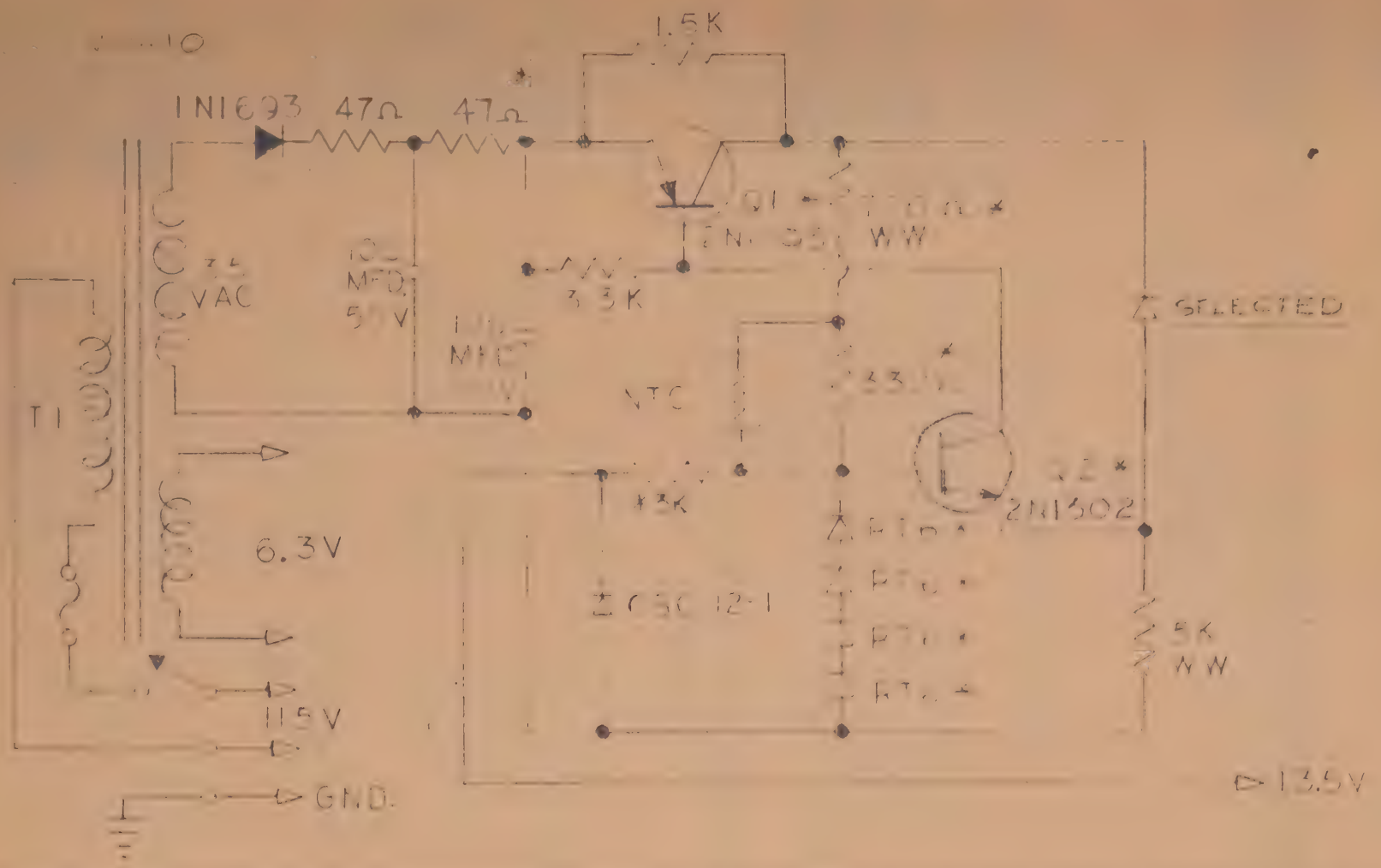

* FACTORY SELECTED

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REF. SUPPLY, SCHEMATIC

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Short Form Catalog Sheet 61

Calibration Standards Corporation

ELECTRONIC TEST INSTRUMENTATION FOR INDUSTRY

MODEL DC-200AR

ALL-TRANSISTORIZED DC VOLTMETER

ACCURACY TO ±0.01% +5UV ABSOLUTE

The Model DC-200AR is the most precise differential voltmeter to be found—unmatched in reliability, unbeatable in price. It is compact and lightweight... uses transistors and zener diodes exclusively...is *self-calibrating*...and warms up completely in less than 30 minutes. It is designed for standard lab calibration, general testing and production testing.

range: 0 to 1000 volts D.C.
pot accuracy: ± 0.002%
temp. stability: 2 PPM/°C. from 10 to 40°C.
regulation: ± 0.001% for a 10% line change
long term stability: reference and potentiometer better than .003%
size: 7" x 19" panel, depth behind panel 5½"
weight: 9 lbs. (net) (shipping wt. 15 lbs.)
price: $985.00*

MODEL DC-100A

ALL-TRANSISTORIZED DC VOLTMETER

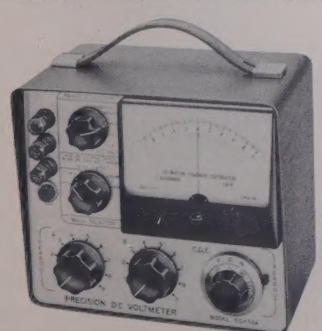
ACCURACY TO ±.05% +5UV ABSOLUTE

The CSC Model DC-100A is a precision D.C. Voltmeter that combines an extremely wide measurement range with a high degree of accuracy and stability...for use from general production testing to precise lab calibration. With the DC-100A, you get a lightweight, portable instrument that's *self-calibrating*, fully transistorized and ready for use the moment it's turned on.

RANGE: 0 to 1000 volts D.C.
STABILITY: ± .005% from 100 to 130 V.A.C.
LINE VOLTAGE: 117 V.A.C.—60 cps—less than 3 watts
WEIGHT: 7 lbs. (net) (shipping wt. 9 lbs.)
SIZE: 8" w., 7" h., 6" d.
PRICE: $475.00*

MODEL DC-110A

ALL-TRANSISTORIZED DC VOLTMETER



ACCURACY TO ±.025% +5UV ABSOLUTE

For premium accuracy at much-less-than-premium price, the Model DC-110A provides a rugged, compact, completely self-contained, precision DC Voltmeter that is ready to use the moment it is turned on. It's completely transistorized, with an ultra-stable zener package for reference. Simple to operate, the DC-110A is *self-calibrating* and easily portable between laboratory and production line.

range: 0 to 1000 volts D.C.
stability: ± .005% from 100 to 130 V.A.C.
temp. stability: 3 PPM/°C.
size: 8" w., 7" h., 6" d.
weight: 7 lbs. (net) (shipping wt. 9 lbs.)
price: $595.00*

MODEL VA-100A

ALL-TRANSISTORIZED VOLT-AMP METER

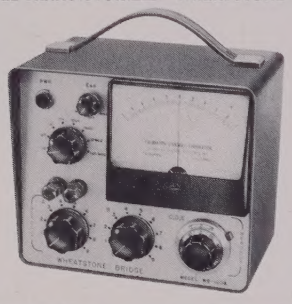
VOLTAGE AND CURRENT ACCURACY TO ±.05% & ±.1%

The CSC Model VA-100A precision volt-amp meter combines all the features of the Model DC-100A voltmeter —such as wide range, high accuracy, extreme stability and *self-calibration*— plus a current measurement capability to an accuracy of better than ±0.1%. It is designed for standard lab calibration, general testing and production testing.

RANGE: 0-1000 Volts
0-1 Amp
VOLTAGE ACCURACY: ±.05% + 5 uv absolute
CURRENT ACCURACY: ±1% + .001 ua
WEIGHT: 7 lbs. (net) (shipping wt. 9 lbs.)
SIZE: 8" w., 7" h., 6" d.
PRICE: $625.00*

MODEL WB-100A

ALL-TRANSISTORIZED WHEATSTONE BRIDGE



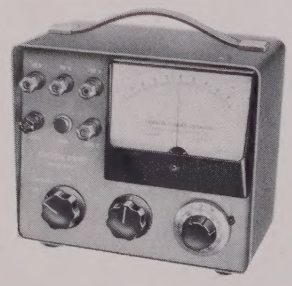
GALVANOMETER, POWER SUPPLY AND BRIDGE...IN 1 PACKAGE

The unique CSC Model WB-100A offers a highly accurate, ultra-sensitive Wheatstone Bridge, transistorized chopper readout amplifier, and bridge voltage power supply... all packaged together in a single, compact, portable unit... priced at what you'd expect to pay for the Bridge alone! High resolution of 5-digit readout is provided over the full range.

ACCURACY: ±.05% +.005 ohms absolute
RANGE: 1 ohm to 100 megohms
SENSITIVITY: 1 mv for full scale
WEIGHT: 7 lbs. (net) (shipping wt. 9 lbs.)
SIZE: 8" w., 7" h., 6" d.
PRICE: $495.00*

MODEL RM-2A

ALL-TRANSISTORIZED REGULATION MONITOR



VOLTAGE REGULATION STABILITY MEASUREMENT

The CSC Model RM-2A is specifically designed to measure voltage stability and to final-check D.C. regulated power supplies. As such, it provides a compact, highly sensitive and stable package that eliminates the need for specially constructed, involved test set-ups... substitutes instead an easily portable, inexpensive instrument with straightforward circuitry and easy readout.

VOLTAGE: 2-500 Volts DC
SENSITIVITY: .1%, 1%, 10% Full Scale
STABILITY: 5 PPM/°C from 10-40°C
WEIGHT: 7 lbs. (net) (shipping wt. 9 lbs.)
SIZE: 8" w., 7" h., 6" d.
PRICE: $325.00*

MODEL AC-100A

TRANSISTORIZED AC-DC VOLTMETER

ACCURACY TO ±.05% +5 UV DC AND ±.2% ABSOLUTE AC

The Model AC-100A AC-DC Voltmeter is a compact potentiometric instrument for measuring both AC and DC voltages to a high degree of accuracy. Transistorized throughout, it provides rugged portability with a converter frequency range of 30 to 10,000 cps. It has 5-digit readout and a simple operation that is the same for both AC and DC measurement.

RANGE: 0—1000 volts DC; .5—1000 volts AC
REF. STABILITY: ±.002% for a ±10% line change
INPUT POWER: 105-125 volts AC; less than 6 watts
WEIGHT: 8 lbs. (net) (shipping wt. 10 lbs.)
SIZE: 8" w., 7" h., 6" d.
PRICE: $795.00*

*F.O.B. ALHAMBRA, CALIF.
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Calibration Standards Corporation

1025 WESTMINSTER AVE.
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